15 Transmission reliability

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| Key points |
| * Reliability settings for transmission networks in the National Electricity Market (NEM) are important for network planning, operation and performance. * Underinvestment in reliability can have large costs, especially if it leads to power outages that cause significant detriment to consumers * Ensuring a network is reliable can also be costly to consumers, requiring investment in network augmentations, network maintenance and replacement, and other non-network solutions. * Standards for reliability in the NEM differ markedly between jurisdictions although three main types of framework can be identified: one uses deterministic standards, one uses probabilistic planning and the third a combination of both. * None of the three currently used frameworks for reliability settings in the NEM is efficient (using efficiency criteria covering investments, standards, administration and compliance, NEM-wide effects and auditing compliance). Efficiency assessments of all three identify important characteristics for a new national framework. * The same criteria can be used to assess the models for a new national transmission reliability framework currently being debated within the industry. * A NEM-wide transmission reliability framework (that explicitly sets reliability standards to maximise net benefits) should generate large efficiency benefits throughout the NEM. * A framework designed to ensure reliability standards are efficient most likely would: * take a NEM-wide perspective and displace any existing jurisdictional requirements * use a probabilistic process (with appropriate values of customer reliability) as part of a cost-benefit analysis of augmentations for reliability purposes * have an independent, third party responsible for reliability settings, with enforced transparency requirements * be integrated with the incentives in the Service Target Performance Incentive Scheme for reliability performance * encourage planning, and operational and performance actions to meet reliability requirements cost effectively, including using dynamic ratings on equipment. * An efficient transmission reliability framework could produce net present value savings in the realm of $1 billion within a single regulatory period, but much more over the long-run. |
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## 15.1 Introduction

The majority of power interruptions that customers experience within the National Electricity Market (NEM) result from faults or failures in distribution networks.

In contrast, transmission networks typically deliver high levels of reliability — indeed, transmission networks are said to be ‘inherently reliable’ (AEMC 2011e, p. 2). Transmission reliability needs to be high due to the size and scale of transmission networks and, thus, the magnitude of the consequences if transmission networks were to fail for any significant period of time (box 15.1).

Reliability settings for transmission networks apply within the context of network planning, operation and performance (box 15.2). They determine the reliability of transmission networks in the short term (within an operational timeframe ranging from the instantaneous through to several months into the future) and in the longer term (within a planning timeframe ranging from a few months to several decades into the future). They also determine how transmission businesses respond once an interruption has occurred (through performance standards).

Reliability settings, which are currently primarily the responsibility of individual jurisdictions, are a major driver of the costs of investment in transmission networks (AEMC 2008a).[[1]](#footnote-1) Thus, inefficiencies in reliability settings can lead to inefficiencies in transmission network investment.

Indeed, the interaction of jurisdiction-based reliability settings with incentive regulation was a matter of concern for some participants. For example, the Australian Energy Regulator (AER) was critical of reliability settings and, in particular, the:

... ambiguity inherent with deterministic reliability criteria, and the wide degree of scope this allows [transmission network service providers] to interpret and apply such standards ... [S]ignificant linkages exist between the standards and the regulatory processes used to set regulated revenues and to assess network performance. Poorly defined reliability requirements make it difficult for the AER to assess whether the capital expenditure proposals of [transmission network service providers] are genuinely required to meet reliability requirements. (AER in AEMC 2008a, pp. 14, 16)

Some have even called the capacity to use reliability standards as a basis for inefficient investment the ‘Trojan Horse’ strategy. Others, using less colourful analogies, have argued that:

… divergent transmission standards across the NEM result in … potential for undue influence and discretion for [transmission network service providers]. (The Group,[[2]](#footnote-2) cited in AEMC 2008a, pp.)

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| Box 15.1 The significant costs of unreliable transmission networks |
| Some of the most significant blackouts worldwide have resulted from inadequate planning, maintenance or operation of transmission networks in response to one or several contingencies (Cepin 2011, p. 16). For example:   * A blackout in Italy and Switzerland (28 September 2003) which affected 56 million people for 48 hours was caused by the operational overloading of a transmission line in Switzerland on a hot day, causing the line to sag and arc to the trees below. Power flows on the inter-network connections between Italy and its neighbours were cut in response to the failed Swiss transmission line, causing the Italian power system to collapse. * Moscow (25 May 2005) experienced a blackout estimated to have caused damage to the value of $US 70 million as a result of the failure of two electrical transformers that were reported to be ‘exhausted’. A combination of old and damaged transmission infrastructure and mistakes by operational personnel are said to have been the cause of the blackout. * Severe outages in the United States and Canada (14 August 2003) that affected 260 power plants and tens of millions of people (some for up to eight days), and caused 61 800 MW of lost load, were caused by a combination of factors, including inadequate real time information available to network operators, failure to manage tree growth in easements, and a failure to manage network effects across interconnected regional networks. * 10 million people across Germany, France, Belgium, Spain and Austria were without power on 4 November 2006 due to errors of a transmission system operator in Germany, inadequate system security procedures, lack of information relayed to system operators in connected networks, and inadequate redundancy in the networks. * In late July 2012, India faced massive system failures that cut power to around 670 million people or around 10 per cent of the world’s population (Yardley and Harris 2012). * The economic cost of outages in some African countries amounted to around 6 per cent of their annual GDP (Foster and Briceno-Garmendia 2010). |
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This chapter focuses on reliability settings within transmission planning frameworks, since these have the greatest effect on overall transmission network reliability. Using a set of criteria, the chapter describes and assesses the efficiency of existing frameworks, and a recent model proposed by the Australian Energy Market Commission (AEMC). The chapter then draws conclusions about the desirable characteristics of a new framework for transmission reliability in the NEM. Operational and performance standards are addressed briefly towards the end of this chapter.

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| Box 15.2 Reliability settings in transmission networks |
| Each jurisdiction’s reliability settings are a critical factor in transmission planning, operation and performance. Planning, operational and performance standards are designed to influence the likelihood, size and the duration of an outage.  Reliability of the network in the operational timeframe is largely controlled by network operators. The National Electricity Rules (schedules 5.1a and 5.1) specify that the network must remain in a secure operating state.[[3]](#footnote-3)  Requirements for reliability beyond those specified in the Rules are mostly set at the jurisdictional level, except the NEM-wide standard that unserved energy per year for each region must not exceed 0.002 per cent of the total energy consumed for that year.  Transmission businesses also set standards for the proportion of line and transformer capacity that can be used at any given time. This can affect congestion on transmission lines and the order of dispatch of generation (chapter 18).  Post-interruption performance standards exist to prompt transmission businesses to respond quickly when an outage occurs. Some elements of performance are captured in standards set by jurisdictions, and performance is also part of the AER’s Service Target Performance Incentive Scheme for transmission.  In the planning timeframe, jurisdictional planning standards aim to ensure that as demand changes, networks can continue to operate in a secure state given the contingency events that might arise.[[4]](#footnote-4) |
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## 15.2 Frameworks for transmission reliability

Within the NEM, each jurisdiction has a separate planning framework for setting reliability standards for transmission businesses (table 15.1). The frameworks vary in the:

* type of standards applied and the level of discretion businesses have when meeting them
* level of standards, both within jurisdictions where standards in central business district (CBD) areas are usually higher than elsewhere, and between jurisdictions even for similar types of location and customer
* body responsible for setting standards and the instruments used to specify them, including codes, licence conditions, legislation and Network Management Plans.

Table 15.1 Transmission network reliability standards under existing planning frameworks**a**

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| State | Type of standard | Standard | Source of standard |
| NSW | Deterministic | N-1 everywhere, except CBD of Sydney where it is N-2 | Contained in Transmission Network Design and Reliability Standard for NSW from the Department of Industry and Investment |
| Vic | Probabilistic planning | Standard depends on the value of customer reliability (VCR) used at each connection point. The higher the VCR, the higher the standard (Melbourne CBD has the highest VCR) | Sections 50C and 50F of the National Electricity Law |
| Qld | Deterministic | N-1 everywhere and includes generation assets (sometimes expressed as N-1-G) | Transmission Authority (licence) issued under S.34 of the Queensland Electricity Act 1994 |
| SA | Expressed as deterministic, but changes are made based on probabilistic analysis | Six (soon to be five) categories of standard specified at connection points ranging from N to equivalent N‑2 for line and transformer capacity. Categorisation depends on VCR at that point | Electricity Transmission Code administered by ESCOSA with advice from the Australian Energy Market Operator |
| Tas | Deterministic and performance based, according to limits on size of load interrupted or duration of interruption | For intact system:  N-1 for connections >25 MW.  No asset failure will interrupt >850 MW  No credible contingency will cause unserved energy >3000 MWh  For network element out of service, no credible contingency to cause unserved energy of >18 000 MWh | Regulations recommended by Tasmanian Reliability and Network Planning Panel of the Tasmanian Energy Regulator and issued by Tasmanian Government |

a Deterministic standards and probabilistic planning are described in boxes 15.4 and 15.6 respectively and VCRs are discussed in chapter 14.

*Source*: AEMC (2008a).

Each planning framework is a reflection of the historical development of the electricity network in the particular jurisdiction prior to the NEM. The final report of the COAG Independent Review of Energy Market Directions in 2002 noted that the Panel was ‘very much aware of community and hence government sensitivity to issues of supply reliability’ (MCE 2002, p. 8), which underpinned the reluctance of jurisdictions to relinquish control of reliability settings in their networks.

While significant variations between jurisdictions exist, it is possible to assign each jurisdiction’s framework into one of three broad planning frameworks for setting transmission network reliability standards:

* the use of deterministic standards in New South Wales, Queensland and Tasmania
* probabilistic planning in Victoria
* the use of hybrid standards in South Australia.

There has also been considerable debate around a possible national framework for transmission reliability. The Final Report of the AEMC’s *Transmission Reliability Standards Review* found that most parties agreed with a national framework, but differed in how they envisioned that framework, and most particularly, its scope to allow jurisdictions to set their own standards (AEMC 2008a, p. 13). The debate currently revolves around two models for a national framework for transmission reliability and planning:

* an extension of Victoria’s probabilistic planning process to the rest of the NEM (referred to as the ‘AEMO planner model’)
* the AEMC’s preferred model.

As such, four broad frameworks either exist or are being considered in the NEM. The remainder of this section describes these frameworks and assesses the efficiency of levels of reliability that are determined within them.

### Approach to assessing planning frameworks and reliability standards

The efficiency of reliability standards within transmission planning frameworks can be assessed in three main ways, including:

* how the frameworks influence the choices that transmission businesses make about the various options for meeting reliability standards
* whether the standards themselves are set using a methodology based on the value consumers place on reliability (chapter 14)
* how costly the frameworks are to administer and to comply with.

A comprehensive assessment also requires taking into account key characteristics of transmission networks (box 15.3).

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| Box 15.3 Characteristics of transmission networks in the NEM |
| There are three key characteristics of transmission networks that are important in a consideration of transmission network planning in the NEM.  First, from a consumer’s and regulator’s perspective, reliability in transmission networks is less easy to observe than in distribution networks. Transmission networks are planned so that, for the most part, interruptions are avoided. Reliability standards for transmission networks target indicators of the *likelihood* of interruptions. These can include redundancy in the network, the probabilities of contingencies occurring, and network availability.[[5]](#footnote-5)  Second, the power flows in, and reliability of, a transmission network within any NEM region affects the entire NEM, so that a problem in one part of the network can surface some distance away. These ‘network effects’ mean that reliability standards need to consider the effect that changes to a network in one region can have on a network in another. This suggests that an assessment of the efficiency of standards must take account of the costs and benefits incurred throughout the NEM.  Third, and related to the above point, the meshed nature of parts of transmission networks and the interconnection of transmission networks in the NEM mean that failures in one part of a network can, if only rarely, ‘cascade’ into other interconnected networks, causing mass outages. Cascading failures can have high costs (potentially more than a transmission business could bear, or even insure for at a reasonable cost, if it were required to fully compensate customers). |
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These characteristics require that the efficiency of reliability frameworks is assessed with a NEM-wide perspective including by considering how well the frameworks:

* assist with the management of the national grid
* encourage neutrality in choices between intra- and inter-regional network and non-network solutions
* deal with network effects and the possibility of cascading failures through the NEM.

A further consideration is whether the frameworks incorporate auditing of facilities and processes in transmission networks to assess the latent and actual reliability of networks. The reliability of transmission networks is hard to observe using a set of key output measures of performance. Therefore the only way of assessing the inherent reliability of such networks is to both:

* specify in some way what needs to be done to achieve a given level of reliability
* utilise methods to confirm that the transmission business is actually doing what it is supposed to have done.

In this sense, there is an analogy to safety management systems where a set of risk reduction measures are agreed, but then there is an auditing process to confirm that these are in place and operating as intended. Just as for major failures with a transmission network, it is not acceptable just to wait and see if a major safety problem eventually arises.

The broad planning frameworks in the NEM are therefore assessed in terms of the following five broad criteria:

* *efficiency in investments*
* *efficiency of standards*
* *minimising administrative and compliance burdens*
* *NEM wide effects*
* *auditing compliance to ensure reliability and efficiency in the long run.*

## 15.3 New South Wales, Queensland and Tasmania

### Governance

The three state-owned transmission businesses in New South Wales, Queensland and Tasmania — Transgrid, Powerlink and Transend — must comply with planning standards specified in jurisdictional license conditions or under statute. In New South Wales, the Commission understands that the relevant minister set standards in 2005, with advice from Transgrid. In Queensland, standards are contained in Powerlink’s Transmission Authority, issued by the relevant minister in 2004 under the *Electricity Act (1994).* These standards were affirmed by the Somerville report into distribution reliability standards in 2004 (AEMC 2008a, p. 177). In Tasmania, planning standards were set in 2006, based on advice from the Tasmanian Reliability and Network Planning Panel to the Tasmanian regulator. The planning standards in the three States have not been reviewed formally since they were first established.

Failing to meet reliability standards in all three jurisdictions can result in penalties for the transmission businesses. At a maximum, a transmission business can have its licence revoked for breaching the conditions that it is obliged to meet. To date this has never occurred in the NEM.

### Deterministic planning

Transgrid, Powerlink and Transend use deterministic standards as a basis for planning and augmenting the networks to ensure reliability. Deterministic standards build redundancy into the network so that when a contingency occurs, an interruption to power supply can either be reduced or totally avoided (box 15.4).

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| Box 15.4 Deterministic standards |
| Deterministic standards specify how much redundancy needs to be built into a network. Standards are expressed using ‘N-x’ notation, where N refers to the number of elements in a part of the network and x is the number of elements that can fail at the same time without causing an interruption to power supply. For example, a network built to a strict N-1 standard will be able to supply peak load with one element not operating, even if it is the largest element in the network.  For example, in year one, a line in a network has a maximum demand of 800 MW. For this part of the network to be rated at N-1 in year one, two 800 MW lines are required so that if a fault occurs on one, the other line can carry the uninterrupted load. However, demand forecasts predict that by year five, maximum demand will increase to 850 MW. Screening studies by the network business reveal that the growth in maximum demand to 850 MW will mean that the network will no longer meet an N-1 criterion in year five. To meet the criterion, a third line would need to be built on the network, or demand would need to be supplied from another line or reduced (through demand management).  Deterministic standards are referred to as redundancy standards because for most of the time, the extra capacity is not used. If a third line were built in the example above, it would only be used at critical peak demand (which occurs around 40 hours per year (chapter 9)) and only if a contingency occurred on one of the existing lines. |
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Electricity network businesses generally have different deterministic standards for different parts of their networks. For example, in New South Wales, sub-transmission lines and the CBD of Sydney must be built to an N-2 standard. Urban and non-urban loads above 10 MVA[[6]](#footnote-6) must be reliable to N-1, and smaller loads to N-0.

Strict deterministic standards of N-1 or greater require that networks continue to operate without interrupting supply when one or more pieces of equipment fail, including at times of peak demand. For example, a line with an average demand of 200 MW and a peak demand of 400 MW must have additional lines of at least 400 MW capacity in total in order to meet an N-1 standard.

The application of deterministic standards by Transend in Tasmania is an example of a more flexible approach to redundancy planning, in which standards are allowed to be breached for short periods. This recognises that the likelihood that peak demand coincides with a contingency is small. In the example above, this might mean that if peak demand rises to 450 MW, the system will breach the N-1 criteria, but only for around 40 hours a year (chapter 9). If a contingency occurs at these times, the remaining equipment can usually carry extra load, at least for a short period until the problem is fixed or load shedding can be minimised.

Transmission networks link to distribution networks at connection points.[[7]](#footnote-7) At each connection point, distribution businesses provide the transmission business with a demand forecast for the customers connected to each point (box 15.5). The transmission businesses then run these demand forecasts through screening studies to identify parts of the network (‘identified limitations’) that might not meet standards as maximum demand increases.

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| Box 15.5 Demand forecasts for transmission planning |
| Transmission businesses use demand forecasts for each connection point (based on information from distribution businesses) when making their planning decisions. Transmission businesses also aggregate these connection point forecasts to publish a region-wide forecast in their Annual Planning Report. Transmission businesses produce these region-wide forecasts for New South Wales, Queensland and Tasmania. The Australian Energy Market Operator (AEMO) produces the forecasts for Victoria and South Australia.  Concerns have been raised about the incentive that transmission businesses might have to ‘overstate demand and therefore over-invest’ (AEMC 2011f, p. 144).  While maximum demand has often not reached the levels predicted in the forecasts — for example, AEMO found that the actual maximum demands were significantly lower than those forecast by the transmission business for Queensland over a period of five years (AEMO 2011c, p. 10) — this is not necessarily evidence of deliberate over‑forecasting of demand.  However, in 2012, and in response to such discrepancies, AEMO began to release independent region-wide demand forecasts for New South Wales, Queensland and Tasmania (as well as a NEM-wide forecast). The AEMC has recently proposed that AEMO should be responsible for informing the demand forecasts used by transmission businesses for planning in the future (AEMC 2012f, p. v). |
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When the business identifies network limitations, all options are examined for meeting reliability standards into the future. These options might include augmentation of the network, demand management projects, or re-routing the flows through the network to remove some of the pressure on the constrained elements.

Once they have identified their preferred options, Transgrid, Powerlink and Transend include the forecast costs and a brief outline of these options in their revenue proposals to the AER every five years. Because augmentations can take several years to build, the transmission businesses will typically include proposed expenditure in their revenue proposals for projects to address risks to reliability that are not predicted to emerge up until six or seven years into the future.

The AER is responsible for determining whether the expenditure required and the options identified by the businesses are efficient. This exercise requires industry expertise and a detailed knowledge of the likely costs of different options, while also keeping in mind the incentives transmission businesses might have to over or under invest or prefer a particular type of option (chapter 5).

Shortly before commencing a project (with a value greater than $5 million), the transmission business has to undertake a Regulatory Investment Test for Transmission (RIT-T) (chapter 19). This process introduces some transparency and requires that the business canvass several different options for addressing a network constraint. However, according to the AER:

… the framework, and particularly the RIT-T, may not result in beneficial investment occurring … [and] current arrangements for network development would not deliver sufficient new augmentations between regions. There are concerns that the existing arrangements may promote reliability-driven region-centric transmission investment and create incentives on transmission businesses to build rather than explore alternatives. (sub. 13, pp. 26, 28)

It is not apparent that the RIT-T imposes significant constraint on the choices businesses make regarding options or their costs. While the RIT-T has to be submitted to the AER, which confirms that it has been carried out according to the specified process, by this stage the AER have already approved the capital forecast of the transmission business. Despite the word ‘Regulatory’ being included in the name of the RIT-T, this part of the process does not seem to have much, if any, regulatory ‘force’. Chapter 19 discusses this issue in more detail.

### Assessment of efficiency

Using the five criteria set out above, the framework for transmission reliability applied in New South Wales, Queensland and Tasmania can be assessed for possible areas of inefficiency.

#### Efficiency of investments

It appears that the incentive to identify and install the cheapest solution to address an identified network constraint is low:

* deterministic standards create a bias towards network investment solutions. Businesses with strict deterministic standards have a strong incentive to build redundancy into the network to meet standards, rather than identify more innovative solutions, including non-network solutions
* the level and nature of scrutiny applied to the options presented in the RIT-T is probably insufficient to be a motivator for the businesses to identify the most efficient option
* the profit motivation for state-owned enterprises as a driver of behaviour appears to be low (chapter 5). State owned enterprises might also have objectives other than to maximise profits (chapter 7).

The bias towards network solutions to meet deterministic standards is possibly exacerbated by the potential adverse consequences for Powerlink, Transgrid and Transend of not meeting their standards. Consequences can range from a business losing their licence at one extreme, to being required to report to the Minister about the reasons for missing the standard, and outlining a strategy to rectify the situation, at the other. Regardless, any significant outage can have substantial political and reputational effects for network businesses and government, even if no formal penalty is applied. The AEMC noted that:

... jurisdictional reliability standards reflect the political reality that if the lights go out in a jurisdiction, it is the government of the jurisdiction that faces the economic and political consequences and manages the public safety issues arising from a blackout. (AEMC 2008a, p. 168)

The greater the penalty — political, reputational or pecuniary — the greater is the likelihood that network businesses will augment their networks to increase reliability and seek to meet their standards within their own networks (that is, there will be a bias towards intra-regional investments). State-ownership of network businesses in New South Wales, Queensland and Tasmania is likely to increase political intervention arising from network failures, also contributing to the tendency for excessive and inefficient network expenditure (one reason the Commission has recommended privatisation).

#### Efficiency of standards

It is unlikely that reliability standards in New South Wales, Queensland and Tasmania are efficient. This assessment is based less on the levels at which they are set, and more on the failure of the frameworks in which the standards are set to properly incorporate the value of customer reliability (chapter 14).

* The standards are not subject to cost-benefit analysis and do not consider customers’ willingness to pay for the levels of reliability the standards support. In New South Wales, there have been calls for the government to:

… satisfy itself that … current standards for network reliability and security align with customers’ willingness to pay and take steps to ensure that future changes to standards are subject to rigorous cost-benefit analysis. (IPART 2011, p. 14)

* The standards have not changed for at least six years. Given that the efficient level of reliability is a dynamic concept, depending on shifting demand patterns, customer preferences and business costs, it is unlikely that a static set of standards would remain efficient over time.
* It is not clear that the Queensland, New South Wales or Tasmanian state governments have invested in the resources or expertise necessary to set efficient reliability standards for an electricity network business. This is a highly technical and specialist area and there is a likely bias by state governments to err on the side of wanting to avoid the political fallout from power outages without being able to assess the cost implications of their decisions or review the degree to which these accord with the willingness of customers to pay for these reliability standards. There may also be a conflict of interest (real or perceived) when governments set standards for state owned businesses that influence investments, and the subsequent dividends flow back to the governments (chapter 5).

#### Minimising administrative and compliance burdens

Third, and in contrast to the two previous concerns, the administrative and compliance burdens of the frameworks for transmission reliability in New South Wales, Queensland and Tasmania are likely to be low. This reflects that there is no need for comprehensive research into customer preferences as an input into standard setting processes, and the long length of time that standards have remained unchanged. For businesses, the compliance burden appears to be low with businesses dealing directly with the organisation setting the standards and monitoring compliance.

Neither the fourth nor fifth criteria (*NEM-wide effects* and *Auditing compliance to ensure reliability and efficiency in the long run*) are addressed by this type of planning framework.

## 15.4 Victoria and the Australian Energy Market Operator’s preferred national model

### The Australian Energy Market Operator’s role as planner and procurer

Victoria’s planning framework differs considerably from all other regions in the NEM. The Australian Energy Market Operator (AEMO) is responsible for planning and directing augmentations to the Victorian network and, it plans and procures services to achieve this (AEMO 2012e). As such, the Victorian transmission business, SP AusNet, does not receive revenue for capital expenditure for augmentations through the AER revenue determination process (AER 2008c, p. 44). SP AusNet, in consultation with AEMO, has responsibility for replacement of assets, maintaining assets and responding when a failure occurs.

SP AusNet is responsible for ensuring that reliability in the transmission network in Victoria is maintained, subject to the planning decisions made by AEMO. If a planning decision were found to be the cause of significant damage to a third party, AEMO could be liable if it had been negligent in carrying out its statutory planning functions.

AEMO’s objective as a planner in Victoria is to ensure that the transmission network allows it to operate the system within security and system performance obligations, set out in schedules 5.1a and 5.1 of the National Electricity Rules (the ‘Rules’). In doing this, AEMO’s objective is to ensure the network minimises the total delivered cost of electricity to consumers over the long term by basing investment decisions on cost-benefit analysis.[[8]](#footnote-8) AEMO’s planning documents indicate that its objective is to augment the transmission network only when the economic benefits from avoiding interruptions to power supply or congestion, equal or exceed the costs of implementing the augmentation (AEMO 2011c, p. 4).

AEMO publishes the Victorian Annual Planning Report, which assesses the ability of the network to supply forecast demand under a range of supply and demand scenarios:

* in the next five years at each connection point
* across the network in the longer term.

The Victorian distribution businesses jointly publish the Transmission Connection Planning Report that focusses on emerging constraints at each connection point for the next 10 years, using connection point specific demand forecasts. AEMO scales these connection point forecasts to be consistent with the state-wide medium energy growth scenario (AEMO 2012e, p. 7).

### Probabilistic cost-benefit analysis

AEMO identifies emerging network limitations by running screening studies that test whether the network can be operated in a satisfactory state (or returned to a satisfactory state within 30 minutes after a contingency) under future possible demand and generation scenarios. To do this, AEMO uses deterministic descriptors to assess which parts of the network would not be in a satisfactory state under system normal conditions (N), after one contingency (N-1) and after a contingency when one element of the network is already not operating (N-1-1). These are similar to the screening studies that Powerlink, Transend and Transgrid undertake.

Once AEMO identifies an emerging constraint in the network (the exploratory phase in figure 15.1), it develops possible (investment and non-investment) options to remove those constraints, taking into account the long-term plans of distribution businesses and SP AusNet’s replacement and refurbishment plans. Preliminary cost estimates and likely lead times are estimated for each option. AEMO assesses the costs and benefits of any substantial expenditure proposal before it is implemented. It considers the probabilities of contingencies and their resultant impacts on consumers, and sets them against the business costs of various options to address these impacts (box 15.6). The option with the greatest expected net benefit is usually the preferred option.

As costs and benefits change over time as demand changes, AEMO conducts pre-feasibility studies to assess whether augmentations might have future net benefits (figure 15.1).[[9]](#footnote-9) Optimal solutions and their timings are identified and costed in more detail during feasibility studies conducted as part of the RIT-T process. This is a form of a ‘real options’ approach to planning.[[10]](#footnote-10)

Figure 15.1 Australian Energy Market Operator’s annual planning cycle in Victoria

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| Australian Energy Market Operator’s annual planning cycle in Victoria. This figure shows the interaction of the four elements of the planning cycle, namely the exploratory phase, followed by the scoping phase, the pre-feasibility phase and finally the feasibility phase. |

*Data source*: AEMO (2012e, p. 5).

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| Box 15.6 Australian Energy Market Operator’s probabilistic  cost-benefit analysis |
| Once a limitation in the network has been identified during the screening studies (which use deterministic indicators), AEMO applies a probabilistic planning approach to reliability that consists of the following four steps.   1. *Market analysis* involves designing many possible future scenarios using demand and generation forecasts. AEMO uses hour-by-hour spatial demand forecasts for different possible future peak demands, and hour-by-hour generation dispatch data to create demand and generation scenarios, while also taking into account the different likelihoods of exceeding the forecasts. (10 per cent and 50 per cent likelihoods are usually used.) 2. *Network analysis* establishes whether the scenarios threaten the stability of the system in terms of voltages, power flows and equipment ratings. 3. *System operation analysis* assesses the operational actions required under different scenarios in different conditions. Operational actions only occur if the system is not in a satisfactory operating state.[[11]](#footnote-11) Operational actions can include network switching, generation re-dispatch and load shedding. These actions have costs, including interrupting customers’ power when load shedding occurs or dispatching higher cost generators, making power more expensive. The analysis then examines what, if any, operational actions are required if a contingency occurs. Sometimes, analysis is required for four consecutive contingencies to ensure the network returns to a secure operating state.[[12]](#footnote-12) Contingency data, and their likelihood of occurring, are compiled using historical outage data from the Victorian network. 4. The *most likely action value* is calculated by multiplying the probabilities of the scenarios and the contingencies by the costs of the operational actions that would be required in each situation and summing them together.   These four steps estimate the cost of a ‘do nothing’ scenario.  Steps 2 to 4 are repeated for each of the possible solutions to network constraints (such as augmentations or demand management) and compared with the ‘do nothing’ scenario. An option passes a cost-benefit test if it produces benefits above the do‑nothing strategy sufficient to exceed the costs. |
| *Sources*: AEMO (2012e, pers. comm. 10 August 2012); VENCorp (2007). |
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When options to address emerging reliability concerns are separable[[13]](#footnote-13) from the rest of the network and are likely to cost at least $10 million, AEMO calls for tenders for the construction, ownership and maintenance of the augmentation or non-network solution. AEMO specifies the limitation in the network, but not the preferred option it has previously identified. This is to ensure that there is opportunity for parties to submit other, possibly more innovative, options. It allows parts of the network to be contestable, with the advantages that competition brings to incentives for cost minimisation and innovation.

To date, 15 separable projects have gone to tender in Victoria (of which the incumbent transmission business, SP AusNet, has been awarded 13). The outcomes of these tenders are currently commercial in confidence and are not communicated to the AER, and the expenditure is therefore not incorporated in the regulated asset base at the start of the next regulatory period.

When options are not separable, AEMO negotiates with SP AusNet to carry out the development or project. SP AusNet receives revenue for the capital expenditure[[14]](#footnote-14) and operating costs for projects that are embedded in their network or for projects that they have won through the tender process. For non-separable projects, the revenue that SP AusNet receives is rolled into the regulated asset base at the end of the five year regulatory period, and is therefore available for any benchmarking exercises undertaken by the AER.

### Assessment of efficiency

##### Efficiency of investments

The Victorian transmission planning framework appears to support efficient options for meeting reliability constraints. The decisions about what, where and when to build are made by AEMO, or are subject to competitive forces through tendering. AEMO, an expert, independent, not-for-profit planner, has little incentive to make inefficient investment decisions[[15]](#footnote-15) and all investments must pass a cost-benefit test, the last iteration of which is delivered through the RIT-T process.[[16]](#footnote-16)

AEMO also has no reason to prefer network or non-network solutions since it is not influenced by the need to meet deterministic standards. As a result, it can identify the most efficient option, which may be a network or non-network option, or a combination of both.

A further benefit arises from the probabilistic process identifying the most efficient timing of investments. Indeed, in some cases, the difference in outcomes between probabilistic planning and deterministic standards might be one of timing rather than the type or scope of project (Grid Australia, sub. 44).

AEMO’s real options approach, however, has benefits. It outlines a stream of augmentations, each planned to commence at different points in the future according to demand forecasts, and assesses the economic case for each investment as its time for construction approaches, allowing changes in customer values and in relevant costs to be incorporated. The New Zealand Electricity Commission found that adopting a real options approach could result in savings of up to 30 per cent compared with orthodox investment planning methods (Electricity Commission 2006).

The Victorian Department of Primary Industries (DPI) has also argued for a ‘dynamic probabilistic approach’ in their submission to the Transmission Frameworks Review:

DPI considers that a dynamic probabilistic planning approach applied to transmission augmentations is likely to result in more accurate and efficient investment outcomes when compared to the setting of deterministic standards that are applied for a fixed period and which are based on analysis which is likely to become out of date over time as market events evolve. (DPI 2012b, p. 6)

The probabilistic planning undertaken by AEMO, through the use of repeated feasibility studies, incorporates a real options approach and ensures that investments for reliability purposes are not undertaken when the costs (as negotiated between AEMO and the business, or revealed through competitive tender) outweigh the benefits. AEMO only procures or negotiates the investments at the time the projects are due to commence, and customers pay a cost that is equivalent to an informed purchaser in a workably competitive market. In contrast to the situation in New South Wales, Queensland and Tasmania, the cost-benefit analysis in Victoria is conducted and all options explored before approval for the revenue attributable to this capital spend occurs. Box 15.7 discusses the current role and application of the RIT-T in Victoria and elsewhere in the NEM.

The most commonly cited criticism of this model is that investments for non‑separable projects are not decided by a business motivated by a profit incentive. However, this is either not much of a disadvantage, or may indeed have benefits in circumstances where the profit incentives of businesses are weak, or investment decisions are based on objectives other than profit (chapter 5 and 7) or when the experience of planning across the NEM gives AEMO increased exposure to new and innovative ways to address network constraints.

Costs of non-separable projects are negotiated between the business and AEMO, which then approves the required revenue for the business. This process should reveal reasonably efficient costs, provided AEMO is an informed party at the negotiations, and the transmission business does not attempt to inflate its cost estimates as an ‘ambit’ for negotiation. However, it is not necessarily transparent. In Victoria, either party can seek arbitration from the AER if negotiations fail to deliver an agreed cost for a project (although to date this has never occurred).

##### Efficiency of standards

The efficiency of standards in this model is more difficult to assess because probabilistic planning does not use ‘standards’. However, this criterion is concerned with whether the delivered levels of reliability (either through the use of and compliance with standards or through probabilistic planning) are aligned to the preferences of customers.

So long as the data and variables used in the analysis are accurate, probabilistic planning, as a form of cost-benefit analysis should align levels of reliability with customer preferences, taking account of temporary ‘mismatches’ due to the lumpiness of transmission assets. (Box 15.8 explains the difference between probabilistic and deterministic approaches to planning.)

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| Box 15.7 The role and application of the RIT-T |
| The Regulatory Investment Test for Transmission (the Test), as currently designed, has a narrow focus and is not equivalent to the cost-benefit analysis that AEMO carries out in the lead up to a network augmentation in Victoria. Outside Victoria, as discussed in chapter 19, the Test falls short of a comprehensive cost-benefit analysis for a number of reasons:   * benefits do not have to outweigh costs for a project to ‘pass’ the Test if the augmentation is being built for reliability purposes * the transmission business intending to undertake a project carries out the Test — not an independent party * the details of alternatives canvassed in the Test (and their costs and benefits) therefore cannot be rigorously tested by parties outside the business due to the information asymmetries that exist between the business and all others (except perhaps where AEMO is involved in an inter-regional project). * other parts of the regulatory regime, as well as state ownership, can create incentives that cause businesses to prefer options that diverge from a true NEM‑wide efficient solution. Given the above, these incentives will not be overcome by any requirements in the Test.   The Test also has little role in the AER’s revenue determination process for transmission. The only role of any RIT-T in the revenue determination process is that the business must include any augmentation option that has passed a RIT-T in its aggregate capex revenue proposal. (In fact, many capital spending projects do not require a RIT-T and a RIT-T may not have been undertaken at the time the AER makes its revenue determination.) The AER does not approve specific investment projects, but instead provides a revenue allowance that leaves the business with choices about the timing and nature of its overall portfolio of investments (or other strategies required to meet reliability standards) over the regulatory period. Under that approach, the business must build to meet any specified standards, but if it can undertake the projects to achieve those standards at lower cost, it can retain the savings as profits. In that sense, the term ‘Regulatory’ Investment Test is a misnomer as it may have very little bearing on the aggregate capex revenue proposal and may make little difference to what would have been built had the Test not been present.  This is not to say that the present Test has no impact or should be discarded. The information asymmetries mentioned above are not so great that the Test is unable to shed light on the most egregious examples of gold plating, preference for network-based solutions, or intra-jurisdictional preference. Further, it does provide a platform for public consultation of possible alternative options, especially for demand management options.  The ‘RIT-T’ as undertaken by AEMO has a different role, more in keeping with the actual name of the Test. It is an independent cost-benefit analysis and actually determines the nature of the solution (which might not be capex) and the revenue to meet those costs. To have the RIT-T play the same role in other jurisdictions, the AER or some other body could use an objectively appraised RIT-T to determine required investments, but to do so effectively would require impartial advice on specifications, timing, costs and network-wide needs. |
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| Box 15.8 Probabilistic and deterministic planning |
| A framework that delivers efficient levels of reliability can *describe* the network and the reliability outcomes in a number of ways: deterministically; using probabilities of interruptions; using maximum interruption durations or occurrence; or using values of lost load.  Across the jurisdictions in the NEM, there are fewer differences in the way levels of reliability are described than there are how they are set, and what party sets them. For example, Victoria’s probabilistic framework uses deterministic N-1 indicators for its initial screening of the network. South Australia’s hybrid standards are an example of moving from a probabilistic analysis to deterministic criteria. Augmentations of the Victorian network under a probabilistic framework can be converted into a description of the level of redundancy using deterministic terminology. AEMO also converts the NEM-wide 0.002 per cent unserved energy reliability standard into deterministic standards to identify the level of reserve in each NEM region (AEMC 2007a, p. 30).  However*, identifying* an efficient level of reliability must incorporate probabilistic analysis. The behaviour of electricity networks is stochastic in nature and therefore system planning should use probabilistic techniques. In contrast, ‘deterministic approaches … do not and cannot recognise the probabilistic or stochastic nature of system behaviour, of customer demands, or of component failures’ (Zhang et al. 2009, p. 121). This is also recognised by Billinton and Allan (1996), who said that:  … there is no need to constrain artificially the inherent probabilistic or stochastic nature of a power system into a deterministic domain despite the fact that such a domain may feel more comfortable and secure. (p. 4)  AEMO’s probabilistic planning might not always be best practice, and neither do all deterministic standards necessarily result in inefficient reliability levels. Joskow and Tirole (2007) asserted that  … there continues to be a lack of adequate communication and understanding between economists focused on the design and evaluation of alternative market mechanisms and network engineers focused on the physical complexities of electric power networks and the constraints that these physical requirements may place on market mechanisms. (p. 61)  Some form of probabilistic planning can reconcile these two agendas. Whether the required communication between economists and network engineers requires translating probabilistic outcomes at the time of investment into deterministic descriptors should be a secondary consideration. |
| *Sources*: AEMC (2007a); Billinton and Allan (1996); Joskow and Tirole (2007); Zhang et al. (2009). |
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However, there are several concerns about the extent to which AEMO’s probabilistic process currently delivers efficient levels of reliability.

First, there are some concerns about the quality of the modelling, parameters and data.

* Some low probability catastrophic events are difficult to model because there is insufficient historical data to determine the probabilities. This complexity increases where a set of interdependent effects may lead to catastrophic failure. For example, a hot day may lead to the coincidence of peak demand, a failure of a transmission line due to arcing, inadequate water to feed hydro generators (if the hot day coincides with a prolonged drought), fires that take out interconnectors, and shortages of maintenance crew at parts of the network that need repair. Given their possible lack of independence, the probability of such events cannot be calculated as the multiple of the probabilities of the events occurring separately (which has apparently been AEMO’s approach). Ignoring dependence would underestimate the true likelihood of catastrophic failure. However, AEMO has begun to incorporate hypothetical high impact, low probability events in its planning, rather than only accounting for events captured in the historical data.
* There are uncertainties about the quality of the data (and the methods) used to estimate the value of customer reliability (chapter 14). It is crucial to take account of all the costs imposed on customers from operational actions (such as load shedding or dispatching more costly generators) when making efficient investment decisions, even if the costs are difficult to measure. If nothing else, a range of VCRs should be used in modelling.

Second, some participants in this inquiry have described the planning approach used by AEMO as a ‘black box’ because the process is not transparent or easy to replicate. Some stakeholders have also raised concerns about the lack of scrutiny of AEMO’s planning decisions and the difficulty external parties might have in testing them.[[17]](#footnote-17)

These are legitimate concerns. Introducing mandatory reporting to the AER and making all processes transparent, would make testing the efficiency of AEMO’s planning decisions easier and would ensure that decisions are made as a result of robust cost-benefit analysis. It appears that AEMO has partly recognised the issue, and has recently publicly released more documentation about its planning process, including its database of scenarios and contingencies.

#### Minimising administrative and compliance burdens

The complexity of AEMO’s planning process and analysis suggests that it is likely to be more costly than the equivalent in New South Wales, Queensland and Tasmania. While the software required is similar to that used in other states, the additional costs arise from the labour costs to run the simulations; the compilation and upkeep of the required datasets including identifying the probabilities of different contingencies; and the design of the scenarios. The separation of functions between AEMO and SP AusNet also makes constant communication between the organisations a necessity.

For SP AusNet, and other competing businesses, tendering for a separable project can also be costly. These costs are discussed in more detail in section 15.8.

#### NEM-wide effects

While the jurisdiction-based focus of the planning in this framework currently rules out explicit consideration of NEM-wide efficiencies, AEMO’s joint role as Victorian planner and operator of the NEM suggests that network effects are likely to be considered. The probabilistic nature of the planning can also more easily integrate inter-regional solutions.

In considering the extension of this model to the rest of the NEM, incorporating detailed representation of the entire NEM in the model/s that AEMO uses in its probabilistic planning would effectively *take account of NEM-wide effects*. AEMO would concurrently therefore become responsible for the national grid.

#### Auditing compliance to ensure reliability and efficiency in the long run

As far as the Commission is aware, AEMO does not carry out independent auditing of facilities or processes in SP AusNet’s network.

## 15.5 South Australia

### Governance

Transmission planning and operation in South Australia is set out in the Electricity Transmission Code, which is administered by the Essential Services Commission of South Australia (ESCOSA).

AEMO plays an important advisory role for planning standards in South Australia.[[18]](#footnote-18) It regularly (and publicly) reports on the state of the network and provides advice on the planning and maintenance of transmission equipment in South Australia. AEMO’s advice is wide ranging and includes advice on the setting of reliability standards in South Australia and the appropriate capital expenditure required to meet them for each revenue determination period. (AEMO does not advise on replacement or operating expenditure.) The advice AEMO issues to ESCOSA and ElectraNet is not binding. However, the Commission understands that the AER takes account of AEMO's capital expenditure recommendations to ElectraNet.

### Hybrid reliability standards

The Electricity Transmission Code sets out the requirements for transmission networks and services in South Australia, including planning standards for the network and connection points. The planning standards are specified deterministically according to six categories of redundancy (which will reduce to five categories from 2013). Each connection point is categorised into one of the six levels of redundancy (ESCOSA 2012). Originally, the categories were determined by assessing the redundancy that existed in the network in the 12 months prior to the establishment of the Electricity Transmission Code in 1999. The intention was that customers would not experience a reduction in reliability after network privatisation.

Every five years, the categorisation of each connection point is reviewed by AEMO at the request of the South Australian Government. The review process uses a probabilistic framework to assess whether changes in the forecast maximum demand at a connection point warrant its reclassification to a higher, but not lower, category of redundancy.

This assessment is made by carrying out a probabilistic analysis of the network, and specifically the connection point, to determine whether the expected costs of interruptions (calculated by multiplying the probability of interruptions occurring by the costs incurred by customers from interruptions) are larger than the cost of reducing the probability of interruptions occurring by investing in the network. If the expected costs to customers are very large (which would most likely be due to increases in demand and therefore larger effects of an interruption at the connection point) several investment options might be justified. If this is the case, the ensuing redundancy in the network as a result of the new investments would correspond to a higher reliability category for that connection point. Connection points cannot currently be reclassified to a lower category.

The probabilities of contingencies used in this analysis are derived from historical observations in South Australia and are supplied by ElectraNet. If AEMO identifies potentially costly constraints, then it assesses the benefits of addressing these against their costs. However, unlike in Victoria, AEMO does not undertake an independent assessment of possible upgrade options and their costs, including demand management options, but must use the cost estimates of the augmentations specified and determined by ElectraNet.

### Assessment of efficiency

#### Efficiency of investments

The hybrid model is likely to be more efficient than current arrangements in New South Wales, Queensland and Tasmania because the deterministic standards at least initially reflect probabilistic modelling, and because the views of AEMO are factored into the AER’s revenue determinations.[[19]](#footnote-19) The private ownership of ElectraNet also increases the likelihood that incentive regulation will function better (chapters 5 and 7).

ElectraNet also undertakes a RIT-T shortly before an augmentation project is due to begin, but this suffers from the same deficiencies as in New South Wales, Queensland and Tasmania.

#### Efficiency of standards

There are several deficiencies in South Australian reliability standards. As recognised by industry participants:

* Reliability standards may be too high. Standards for connection points were set to the level of reliability that existed when the state government owned and operated the network. The original reliability standards were not based on customers’ value of reliability. The fact that a connection point cannot be re-classified to a lower level of reliability can entrench inefficient historical standards or fail to respond to new demand patterns.[[20]](#footnote-20)
* The lumpy nature of the reliability categories creates inefficiencies. There are only six (soon to be five) categories into which connection points can be classified. With a limited number of defined categories, it is not possible to take a more granular approach to reliability standards. Moreover, classifications are rounded up so that there is always a bias to a higher requirement for reliability.
* The lack of independent analysis of possible options (including non-network options) for achieving the reliability standard of a connection point calls into question whether the upgrade costs and options are efficient. While AEMO might be able to tell when the options and costs provided by ElectraNet are significantly overestimated, it has no recourse for identifying and recommending alternatives. AEMO recognises this in its review of capital expenditure by emphasising the need for detailed planning and capital assessments through the RIT-T (AEMO 2012d p. iii).
* The value of the VCR used in the cost-benefit analysis does not reflect possible differences in industry composition or customer preferences specific to South Australia.[[21]](#footnote-21)
* Ultimately, AEMO’s recommendations about the reliability categorisation of connection points are only recommendations — ESCOSA is under no obligation to accept them.
* There can be a gap of up to seven years between the timing of the reliability assessments for a connection point and the RIT-T for the relevant investments (AEMO, sub. 32, p. 11). Even if the reliability category applied to a connection point (and the preliminary costings of options used to set it) were efficient and reasonably accurate in the lead up to the revenue determination, this might not remain so by the time the investment close to commencement. As for New South Wales, Queensland and Tasmania, at the time that the RIT-T is carried out the required revenue has been approved, and the RIT-T process appears to be more of a formality rather than being a comprehensive review of the options, the detailed specification of the preferred option, and an updated estimate of the capital required to confirm the efficiency of the augmentation.

#### Minimising administrative and compliance burden

The administrative and compliance burden of the transmission planning framework in South Australia appears to be moderate. The input of AEMO and ESCOSA and their interactions with the business, and the resetting of standards every five years impose some costs. However, in between revenue determinations, only AEMO’s advisory role seems to differentiate the South Australian framework from those in New South Wales, Queensland and Tasmania.

#### NEM-wide effects

AEMO’s involvement in South Australia through its advice to ElectraNet suggests a consideration of network effects and inter-regional solutions, at least with Victoria.

#### Auditing compliance to ensure reliability and efficiency in the long run

The Commission is not aware of any independent auditing of the facilities and operation of ElectraNet’s network.

## 15.6 The AEMC hybrid model

In considering a possible national framework for transmission reliability, the AEMC has developed a preferred model. This is mostly set out in the second interim report of the Transmission Frameworks Review (2012b) and the Transmission Reliability Standards Review (2010a), the latter of which was largely endorsed by the MCE (2011). Through these reports (and others, including the National Transmission Planning Arrangements (2008a)), the AEMC has mapped out a set of reforms to reliability and planning in transmission networks, that seeks to address many of the concerns that have been discussed above.

For setting reliability standards in the NEM, the AEMC’s preferred model is largely based on the planning framework operating in South Australia, with several amendments to address some concerns with it (as discussed above).

Briefly, the main features of the model are as follows:

* AEMO would develop a national template of deterministic standards to be applied to connection points (or ‘some other readily understandable basis’) in all transmission networks. This template is likely to be similar to the categories currently applied in South Australia.
* Each jurisdiction would appoint a body to set reliability standards for each connection point in the regional transmission network. The standards could correspond to the national template or could differ if the jurisdiction considered this to be more appropriate.
* The standards would be ‘economically-based’ and would take the ‘hybrid form’. While not specified in detail, the Commission understands that the process of applying a specific standard to each connection point would involve probabilistic analysis as currently done by AEMO in South Australia.
* The MCE has stated that ‘the body responsible for setting reliability standards would be independent of the body required to meet the agreed standards’ (2011).
* Every five years, the application of the standards in each network would be reassessed and connection points could have their standard changed to a higher or lower level of reliability depending on the preferences of customers in that area. There would also be an option for a ‘flexible approach’ under which a transmission business could apply to bring forward or defer an investment if it could show there were economic benefits to doing so.

For transmission planning in the NEM more generally, the AEMC has also recommended several additional planning requirements intended to better integrate local and national planning and to address concerns about an intra-regional bias of investment that might emerge from jurisdiction-specific deterministic criteria. According to these recommendations, AEMO’s role as the National Transmission Planner (NTP) would be expanded to include:

* identifying possible future inter-regional investments during the process of developing the National Transmission Network Development Plan
* reviewing draft annual planning reports and draft RIT-Ts of the transmission businesses, and highlighting where transmission businesses may be able to coordinate their investment programs or identify and agree on options in other regions that may help to address a constraint or reliability risk
* providing demand forecasts for each region for use as a starting point for the forecasts used in transmission planning. Transmission businesses would be required to explain any departure from these forecasts to the AER.
* acting in an expert advisory role, including to the bodies responsible for setting hybrid reliability standards in each jurisdiction
* administering (with AER oversight) a NEM-wide system of inter‑regional transmission pricing to achieve recovery on a beneficiary pays basis of the cost of inter-regional investments, including from users located in different regions from the relevant investments
* assuming the Last Resort Planning Power[[22]](#footnote-22) (LRPP) currently held by the AEMC.

To support AEMO in this role and to further pursue inter-regional connections in the NEM, transmission businesses under the AEMC’s recommended model would:

* be required to consult with each other as they prepare their annual planning reports and RIT-Ts. They would need to promote identification and implementation of network investment options that cross regional boundaries, and explain why they had chosen not to proceed with an inter-regional investment that had been identified by AEMO in its national planning processes
* have their regulatory control periods aligned. Among other benefits, this would allow the AER to allocate the required revenue for inter-regional investment options to the transmission businesses concerned
* formalise the process in which transmission businesses provide input to the NTP. This would include a formal working group comprising representatives of the businesses and the NTP to coordinate local and national issues addressed in the National Transmission Network Development Plan.

### Assessment of efficiency

The AEMC’s preferred model extends the strengths of the South Australian model, and is significantly better than arrangements in place in Queensland, New South Wales and Tasmania.

#### Efficiency of investments

The main positive features of this framework are:

* the model would provide increased oversight of the planning and investment decisions of the transmission businesses in New South Wales, Queensland and Tasmania by formalising AEMO’s role of reviewing the annual planning reports and RIT‑Ts of the businesses. However, concerns remain about how influential these ‘reviews’ would be and whether formalising oversight by AEMO would lead businesses to make more efficient decisions than they currently do under AEMO’s current, less formal, oversighting arrangements[[23]](#footnote-23)
* under incentive regulation, the model motivates a profit maximising business to identify and implement efficient options (within the constraints of the hybrid deterministic standards). The efficient timing of projects, however, will likely only occur where incentives are consistent across the five year regulatory period, which is currently not the case (chapter 5)
* AEMO’s input into the demand forecasts the businesses use for their planning might also reduce the likelihood that the AER approves excessive investments and hence revenue allowances, based on inflated forecasts. However, to be effective, this would probably require that the businesses release all the information they use to determine their connection point demand forecasts. In the absence of this, the AER might find it difficult to question the businesses’ evidence for departing from the AEMO-issued regional level demand forecast
* aligning revenue determination periods should help increase the information the AER can use to assess the efficient level of capex required to meet a given set of reliability standards.

On the other hand, some deficiencies remain, including that hybrid standards (which would be expressed deterministically) create a bias towards network solutions and hence are likely to influence a more constrained consideration of alternative options. This could be exacerbated by the current bias in the incentive regulation away from opex and towards capex (chapter 5).[[24]](#footnote-24)

Furthermore, the RIT-T process is not equivalent to a real options approach (such as that incorporated in AEMO’s probabilistic planning process). Hybrid standards can, in theory, incorporate the changing detail reflected in probabilistic planning (Grid Australia, sub. 44, p. 6 and box 15.8). However, the AEMC’s proposed hybrid approach cannot achieve this because connection points would only be classified into one of a limited number of pre-determined categories in five yearly intervals.[[25]](#footnote-25)

#### Efficiency of standards

The efficiency of the standards in this model and the process of their identification are an improvement on the current approach in New South Wales, Queensland and Tasmania. This is because the standards are based on a cost-benefit analysis, determined by an independent party, and informed by ‘an expert’.

For South Australia, the capacity to move standards applying to a connection point up or down would be an improvement. For Victoria, a move away from a contemporary probabilistic assessment of each significant investment to pre-set deterministic standards would be a step backwards and would likely increase costs for customers in that state.

None of the other concerns discussed with respect to the standards in the framework currently operating in South Australia are currently addressed by this model as it has been currently outlined (including the lumpy nature of reliability categories; lack of independent analysis of options and costs while setting standards; the inappropriate VCR used; no requirement to accept AEMO’s recommendation for connection point reliability categorisation; and the potentially long gap between when standards are set and when the investments to meet them are made). Further, the implementation of a national template of categories of standards could possibly exacerbate the costs that result from ‘lumpy’ categories. Allowing jurisdictions to depart from this national template undermines the benefits from consistency across the NEM.

#### Minimising administrative and compliance burdens

It is difficult to assess the *administrative and compliance burdens* of this model without knowing exactly how the model would be rolled out across the NEM. Allowing jurisdictions to depart from the national template and set their own standards implies that separate bodies might exist in each jurisdiction to carry out probabilistically based cost-benefit analysis to identify efficient levels of reliability. This may not be transparent or efficient.

The compliance costs under this model for businesses in New South Wales, Queensland and Tasmania are likely to increase due to the changes required of the businesses and the ensuing transaction costs.

#### NEM-wide effects

The recent recommendations made by the AEMC (2012j) are intended to develop a framework for transmission planning that takes account of NEM-wide effects. The introduction of a beneficiary pays system would remove an obstacle to inter-regional investments that currently exists and would be a positive step towards a more NEM-wide focus for transmission planning. However:

* it appears that the majority of the recommendations in this model for consultation, cooperation and independent scrutiny mostly formalise processes that already exist and no process has been identified to evaluate the effectiveness of this formalisation.
* the jurisdiction-based deterministically expressed reliability standards are likely to maintain the current intra-regional bias for investments. It is not clear that the increased cooperation between AEMO and the transmission businesses (as proposed by the AEMC) would completely solve this.
* the model makes little progress on appointing a body to comprehensively manage reliability in the national grid. Maintaining jurisdiction-based reliability standards and decisions on augmentations undermines this goal.

## 15.7 Summing up

It should be emphasised that there are no easy solutions for ensuring efficient transmission reliability and planning in the NEM (and indeed this is the experience internationally). A fundamental reason for this is due to the fact that, unlike for distribution networks, it is impossible to rely upon output measures and leading indicators to regulate reliability for transmission networks. All arrangements involve ‘big brother’ in one form or another, whether it be governments, a confederation of network businesses, or a single body, and there are compromises and judgments which must be made. A combination of transparency, accountability, consultation, specialist knowledge, independent decision-making and giving pre-eminence to consumer preferences are the essential components of a workable arrangement. However all arrangements have their pros and cons — there is not any perfect solution.

Nonetheless, the assessment of the existing planning frameworks for transmission reliability against the criteria set out in section 15.2 reveals the strengths and weaknesses of the various approaches.

### Efficiency of investments

* Profit motivated businesses with strong incentives to cost minimise are more likely to identify efficient options for addressing a given reliability constraint. If these incentives are weakened, or business choices are influenced by other objectives, this will not necessarily be the case.
* Identifying which option should be installed, how much it will cost, and when the project should occur is unlikely to be able to be undertaken with any level of certainty or efficiency years in advance of the project commencement. Technology changes, demand, external events and other cost drivers can all change significantly over the course of several years.
* Accurately specifying and costing projects and approving the associated revenue allowances for projects based on this knowledge, closer to their commencement, can help deliver cost savings to customers.
* Competitive tendering can assist in reducing costs and revealing innovation.
* Reliability can be enhanced using network and non-network solutions. Reliability settings (such as the type of standard) and regulatory settings (such as incentives) should not constrain or bias businesses in identifying the most cost‑effective solution to deliver a reliability benefit.
* Independent analysis of costs and benefits can provide greater assurance to governments and consumers of the value of investments
* Transparency in assumptions and models helps generate confidence in investment choice.

### Efficiency of standards

* Levels of reliability are only likely to be efficient if they are identified within a cost-benefit framework.
* A cost-benefit framework requires a measure of the value customers place on reliability, which is a function of the costs they incur when an interruption occurs. VCRs that are robust, current, and disaggregated by relevant area and customer type should be the cornerstone of reliability settings.
* Incorporating VCRs in a planning context requires information on the probabilities of interruptions, and these probabilities must account for all possible contingencies and their likely effects.
* The costs for transmission businesses of providing a reliable network and the costs to customers from interruptions change over time. Reliability settings need to be flexible to reflect the changing nature of the costs and benefits that underlie them.
* Planning standards and modelling should be transparent, with stakeholders able to query methods and results.

### Minimising administrative and compliance burdens

* Transmission businesses (and their owners) have a conflict of interest if they are responsible for both setting reliability standards and meeting them. Reliability settings should be determined by an independent, non-conflicted, well informed third party.
* The process of setting reliability standards and for establishing efficient augmentation solutions should itself be as efficient as possible in terms of costs, timeliness and responsiveness.

### Taking account of NEM-wide effects

* A planning framework should consider the costs and benefits of the effects that reliability settings in one network can have on another (that is, network effects).
* Desired levels of reliability should be delivered using a combination of intra-regional and inter-regional network and non-network solutions — that is, the net benefits should be maximised using a NEM-wide perspective.
* The risk of cascading failure across jurisdictions, the presence of network effects in interconnected transmission networks, and the importance of implementing inter-regional solutions to network constraints when beneficial to do so, suggests that the regulation of reliability in transmission networks in the NEM should be the responsibility of a NEM-wide authority, and not jurisdiction‑specific.
* This NEM-wide authority would be best placed to take responsibility for managing the national grid by developing and managing national transmission flow paths and reliability standards.

### Auditing compliance to ensure reliability and efficiency in the long run

* The difficulty of observing reliability outcomes in transmission networks is only addressed implicitly in the current frameworks. Economic regulations need to recognise the value of reliability and measure the latent and actual reliability of networks. If they do not, incentive regulations may lead to greater short-run profits at the expense of underinvestment in reliability.
* Auditing compliance with reliability standards, including redundancy, and continuing to model the probability of interruptions, to the greatest extent possible, would be required to counter any such motivations, even with standards in place. Auditing whether networks meet deterministic standards would appear to be considerably easier than checking whether probabilistic criteria have been followed appropriately. In Victoria, this issue was addressed by appointing an independent planner (AEMO) with the appropriate resources and expertise. However, even in Victoria, there are grounds for auditing the delivery and performance of new investments, as well as maintenance and replacement projects.

## 15.8 The way forward

In the Commission’s judgment, the way forward for transmission reliability and planning frameworks in the NEM should be through some form of national framework that takes account of the characteristics identified above. The analysis above effectively weighs up two competing alternatives, both of which have considerable advantages over the status quo:

* the AEMC’s hybrid model
* an extension of AEMO’s probabilistic planning, as it currently applies in Victoria, to the rest of the NEM (AEMO planner model). The Commission’s preferred modifications to this model are discussed in the implementation section below.

The Commission’s initial view is that, based on the criteria for assessment, the AEMO planner model offers better prospects for progress towards an efficient national planning framework for transmission reliability (table 15.2). The biggest drawback of the AEMO planner model is that it appears to impose larger administrative and compliance burdens.

Table 15.2 An illustration of possible progress from two national models for transmission reliability from current conditions

NEM-wide average

|  |  |  |
| --- | --- | --- |
| Criteria | AEMC hybrid model | AEMO planner model |
| Efficiency of investments |  |  |
| Efficiency of standards |  |  |
| Minimising administrative and compliance burdens |  |  |
| Taking account of NEM-wide effects |  |  |
| Auditing compliance to ensure reliability and efficiency in the long run |  |  |

However, it is important to assess whether this conclusion would change if several aspects of the AEMC model and the surrounding regulatory environment were improved.

* *strengthening the incentives* under incentive regulationmay improve outcomes under the AEMC hybrid model*.* The Commission has proposed privatisation and significant reforms to incentive regulations. If these were implemented, the efficiency of the AEMC model would be bolstered because businesses would have a greater profit motive to choose the least costly and most innovative approaches to achieving reliability standards. While the medium-term gains would mainly flow to shareholders, over successive regulatory periods, the AER would adjust revenue determinations so that consumers gained more of the benefits. (In contrast, the AEMO model would pass on identified cost savings to customers immediately, but might not always identify the most innovative or low cost option)
* *using more categories for standards* would provide more options for optimising the network (solving the ‘lumpy categories’ problem identified earlier)
* *using a single expert and independent body* to determine efficient options and costings in the standard setting process would provide rigor and independence to determination of standards. At present, the AEMC model does not rule this out, but specification of such a feature would strengthen its approach
* *applying detailed and disaggregated* values of customer reliability (recommendation 14.1) would improve the reliability of the probabilistic approach, which would translate into more appropriate hybrid standards.

Strengthening the incentives under incentive regulation and addressing some of the shortcomings in the hybrid approach would bring the assessment of the costs and benefits of the two models closer together. Reaching a firm conclusion about the relative advantages of one model over the other, however, requires consideration of the relative magnitudes of the benefits encompassed in each of the criteria.

As discussed in chapter 14, delivering efficient levels of reliability, through probabilistic planning (by avoiding inefficient standards expressed deterministically), offers by far the biggest gains to customers compared to the status quo. Delivering reliability by choosing efficient options and passing on cost savings to customers could also deliver significant, but smaller benefits. The benefits from meeting the last three criteria compared to the status quo are much smaller.[[26]](#footnote-26) Given this, the Commission judges that the AEMO planner model could deliver larger net benefits than the AEMC hybrid model. However, there are still some significant disadvantages to the AEMO planner model, which are discussed below.

### Implementation

While the AEMO planner model offers the potential for significant gains for customers, concerns remain about its implementation throughout the NEM. As noted above, extending the Victorian model to the rest of the NEM would probably increase the *administrative and compliance burden* compared with alternative models. In regards to AEMO’s role as a ‘procurer’, some participants in this inquiry have expressed concerns about the costs involved for businesses submitting tenders, for the incumbent transmission business, and for AEMO when carrying out the tender process in Victoria. It is not yet clear whether these costs are mostly due to the specific features of the tendering process in Victoria or to tendering processes in general. Nevertheless, there is a risk that any such costs could grow were the AEMO model adopted on a NEM-wide basis.

Some participants have also claimed that there are requirements to negotiate many contracts with different parties in Victoria, creating significant transaction costs. This could be because of failures to clearly assign liability during the privatisation process in Victoria. Any extension of the AEMO planner model to the rest of the NEM would require clearly allocating default liability settings as part of the implementation process, before any tenders were initiated. This would provide certainty to parties entering into the tendering process, and subsequently to those operating, and connected to, new augmentations, and would possibly largely resolve these transaction cost problems.

A tentative upper bound estimate of the costs of tendering processes in general is around eight per cent of the costs of a project.[[27]](#footnote-27) However, transmission businesses often already tender for major parts of projects. Consequently, the incremental costs of tenders to address a constraint in a network may not be very different from tenders for a pre-specified scope or part of a project, such as installing a new substation. The transaction costs of introducing contestability would be minimised if it were introduced at the same time as a national framework for transmission reliability.

On the other hand, the benefits of tendering for separable augmentation may still be low. For example, this could occur if the market were shallow.[[28]](#footnote-28) It is possible that there might be only a few businesses capable of proposing and designing creative solutions for relieving constraints, and able to subsequently coordinate and operate the entire project. Similarly, the gains may be small if the alternative options to relieve the constraint are well known or there is little scope for innovation.

However, contestability in markets is generally considered to be a desirable feature. Further, while SP AusNet has won the majority of tendered projects in Victoria, it is not possible to estimate their costs in the absence of the discipline of competition. Contestability is an important part of electricity network regulation in the United States (box 15.9).

|  |
| --- |
| Box 15.9 Transmission contestability in the United States |
| Federal Energy Regulatory Commission Order 1000  The Federal Energy Regulatory Commission (FERC) issued Order No. 1000 on July 21, 2011. Among other things, Order No. 1000 directed transmission planners to remove any ‘right of first refusal’ (wherein planners would be required to offer local transmission owners (TOs) the first option to build any given project, limiting contestability). The FERC did not mandate any particular manner of introducing contestability, but did require that planners demonstrate transparent, and non‑discriminatory, criteria and evaluation processes for selecting projects.  Pennsylvania-Jersey-Maryland (PJM)  PJM covers 13 States (and the District of Columbia) in the eastern United States. PJM Interconnection is the Regional Transmission Organisation (RTO) with responsibility for market operation and planning. Where PJM Interconnection identifies an investment needed on reliability grounds (or upgrades existing facilities), it is allocated to the TO with responsibility for the relevant service territory.  For projects justified on economic (not reliability) grounds, PJM Interconnection’s planning process allows a variety of participants to propose solutions to the identified need. PJM Interconnection assesses the proposals and recommends those that pass a cost‑benefit test to its board. While TOs can participate, they are not guaranteed the right to construct a project. PJM Interconnection has successfully argued before FERC that this process is not a ‘right of first refusal’ (Wuslich et al 2012).  (Continued next page) |
|  |
|  |

|  |
| --- |
| Box 15.9 (continued) |
| California  The California Independent System Operator (CAISO) conducts a three phase planning process to identify and allocate transmission investments. In the third phase, CAISO conducts a competitive solicitation process to select the builder and owner of economically- and policy-driven (for renewable energy) projects. Reliability-driven projects are generally the responsibility of the incumbent TO.  New York  In planning for reliability purposes, the New York Independent System Operator (NYISO) conducts an assessment of the future reliability needs of its power system. It then requests market-based solutions from any qualified developer (not just TOs). If the market-based solutions do not address all reliability needs, NYISO can direct local TOs to construct a ‘regulated backstop’ solution.  For ‘economic’ planning, NYISO identifies high cost congestion paths, and seeks proposals for specific projects from developers. In order to be approved, and be eligible for regulated cost recovery, a project must meet three conditions — benefits exceed costs, the capital cost is above $25 million and 80 per cent of the project beneficiaries must vote to approve it. If approved, NYISO allocates costs on a ‘beneficiary pays’ basis (discussed in chapter 19 on merchant interconnectors). |
| *Source*: NERA (2012c). |
|  |
|  |

At this stage, the Commission judges that, on balance, it is not clear that the benefits of contestability offered by AEMO’s role in Victoria as a ‘procurer’ outweigh the complexities and costs of this role. That is, the possible *administrative and compliance costs* associated with contestability could be larger than the benefits of contestability for the *efficiency of investments.* For this reason, the Commission’s preferred model does not involve AEMO as a ‘procurer’.

The Commission seeks information about the potential benefits and costs of introducing contestability into separable augmentations of the network, as currently occurs through the Australian Energy Market Operator’s procurement role in Victoria, and in parts of the United States. The Commission seeks evidence from participants regarding the costs and benefits of contestability including:

* administrative and compliance costs
* the depth of the market (present and potential)
* the extent of efficiency gains available from competitive pressures from contestability for solutions to constraints (as opposed to contestability in detailed construction of a given solution)
* any ongoing cost inefficiencies caused by potentially additional separate owners and operators of the ‘separable’ assets connected to the network.

The Commission also seeks participants’ views regarding the costs and benefits of auditing facilities and processes in transmission networks. What alternative methods are there for the regulator to gain assurance about inherent reliability, in terms of whether transmission businesses are doing either, what they should do (for example maintenance), or whether they have done what they said they were going to do (for example augmentations)? What is international best practice in this respect? What powers should the regulator have if an audit suggests poor compliance?

The Commission considers that several other improvements should be made to address remaining concerns about the implementation of the AEMO planner model throughout the NEM.

* The planner should be subject to greater scrutiny, especially considering the complexity of probabilistic planning processes. Within the NEM governance framework, the AER would be the most appropriate body to enforce transparency and regular reporting of modelling parameters, assumptions and results, and data inputs. Periodic review would also be appropriate to ensure that the planning framework was delivering optimal outcomes in accordance with the National Electricity Objective (NEO).
* Removing network planning from incumbent transmission businesses risks losing the in-depth and localised knowledge that planners in those businesses have accumulated. AEMO should therefore include incumbent businesses in all steps of their planning process and utilise this specific expert knowledge as much as possible, especially in the option identification stage. This interaction and cooperation would also allow AEMO to identify and choose options that exploit operational capacity in parts of a network and thereby make trade-offs between operational and investment decisions.
* The probabilistic process used should be international best practice, and would be strengthened by periodic peer review. One of the first steps, however, is to identify the deficiencies in the data collected by transmission businesses and AEMO, and establish the required collection and reporting processes.
* The VCR is one of the most critical parameters of probabilistic planning. For reliability outcomes to be efficient, VCRs must be identified in as disaggregated way as possible, including by:
* geographical location
* customer type
* interruption duration.
* The consequences of underestimating the VCR might include underinvestment, and over the longer-run, a greater frequency of outages. At the margin, the consequences of overestimating the VCR are likely to be less severe. Given the difficulties with estimating an accurate VCR and the fact that VCR is an aggregate of the differing preferences of many customers, adopting a VCR that is at the higher end of the reasonable range of possible values would be sensible. The ABS would be the most appropriate body to undertake the research required to reveal accurate VCRs (recommendation 14.1).
* The revenue required for projects (separable and non-separable) should be agreed between AEMO and the incumbent business for projects below an appropriate threshold (or through arbitration with the AER when agreement cannot be reached) and communicated to the AER before the commencement of the project. For projects with costs above the threshold, the business should submit detailed costings, based on their own tenders and firm quotes to the AER. AEMO would also submit its own cost estimates to the AER. The final allowed expenditure should then be determined by the AER.
* The AER should include the businesses’ relevant expenditure for both separable and non-separable projects in the regulated asset base at the commencement of the next regulatory period. This would increase transparency and provide the AER with more information to improve benchmarking practices.
* Revenue approved for inter-regional investments should be collected from jurisdictions according to their shares of the benefits derived from the investment.
* AEMO would also carry out auditing of transmission networks, including auditing the performance and operation of critical equipment to ensure transmission businesses were appropriately augmenting and maintaining their networks for the purposes of reliability. It would report the outcomes of these audits to the AER.

### The Commission’s preferred model

In transmission reliability there are no perfect solutions — all options have pros and cons. While being conscious that the AEMC has reached a different judgment, the Commission considers that, with these changes made, the most effective framework for planning transmission networks in the NEM for reliability purposes would include a NEM-wide planner. AEMO would be the most qualified body to carry out the required functions.

As the national planner, AEMO’s current functions in Victoria would be extended to all other regions in the NEM (but with some changes, for example, excluding the ‘procurer’ role).

As part of its cost-benefit analysis of possible augmentations to transmission networks, AEMO would use a probabilistic process, and the costs and benefits would be assessed on a NEM-wide basis to take account of possible network effects. AEMO would use the VCRs estimated by the ABS as recommended in chapter 14.

The AER would be responsible for ensuring AEMO’s planning and auditing processes were transparent and consistent with the NEO.

AEMO would carry out these planning functions for the foreseeable future. However, periodic reviews of transmission reliability settings should be undertaken, with the option of removing AEMO from this role if the evolution of transmission pricing and access arrangements ultimately provide an alternative market-based solution. In particular, the AEMC and the Commission have recommended optional firm access to transmission lines by generators (chapter 18 and AEMC 2012j). This would create market signals for reliability and the relief of some network constraints. However, for the reasons given in chapter 18, it would be premature to discontinue planning for reliability purposes in the NEM until alternatives (such as including the option for market driven transmission investment for both generation and load) were demonstrated as effective.

Of course, just how well AEMO would carry out these functions as a planner throughout the NEM, and whether it would always make efficient decisions in line with the NEO, would depend upon adequate resourcing and effective governance. These issues extend to all institutions in the NEM, including AEMO in its current role as market operator. (Chapter 21 sets out principles of good governance in institutions with regulatory functions — box 21.1.) In considering the details of how this model might be implemented, this type of issue would need to be given careful thought.

Some stakeholders have raised concerns about legal liability and accountability in a model in which AEMO acts as the NEM-wide transmission planner. However, liability costs are likely to be ultimately met by consumers, regardless of the planning model. The most important question is the degree to which alternative models cost-effectively avoid major transmission failures. There are risks associated with the various models considered by the Commission in terms of:

* their cost-effectiveness in the case of models relying on deterministic standards
* the potential for adverse network effects in models that have a less nationally-oriented focus
* any ambiguities about responsibilities for reliability in the case of the Commission’s preferred model.

On the latter point, the Commission understands that there have not been any reliability problems or ambiguity about responsibilities associated with joint roles of AEMO and SP AusNet in Victoria.

The Commission seeks further input on the potential advantages and disadvantages of the Commission's suggested alternative to the Australian Energy Market Commission’s hybrid planning model. How could the Commission’s preferred model be improved? Since a key objective of a national planning framework is to avoid costly system‑wide failures, to what extent do the different models vary in their capacity to achieve that goal?

### An adapted AEMC hybrid model?

A possible, but second best, alternative would be an adapted version of the AEMC’s recommended hybrid model (all models are summarised in table 15.3 below). As previously outlined, the Commission believes that the AEMC model has benefits compared to the status quo but also some drawbacks compared to the Commission’s preferred model. Some of these could be ameliorated by the following changes:

* AEMO would develop the national reliability template based on hybrid standards in consultation with all jurisdictions and the transmission businesses, and revisit it periodically. All jurisdictions would have to use the national template. AEMO should set the standards applied to connection points in all jurisdictions and in doing so, use the VCRs estimated by the ABS as recommended in chapter 14.
* AEMO would expand its advisory role to all transmission businesses, including for draft revenue proposals, as is currently done in South Australia
* Transmission businesses would be able to ignore AEMOs advice and make their investment decisions autonomously. However, they would still need to undertake a RIT-T. Most critically, in making revenue determinations, the AER would accept AEMO’s advised transmission investments as the default, requiring the transmission business to show why its alternatives were more efficient. This would reverse the onus of proof for reliability-driven investment categories under the Rules.

Table 15.3 Summary table of alternative transmission planning models

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | *AEMC hybrid model* | *AEMO planner model (as per Vic)* | *Commission’s preferred planner model* | *Commission’s modified hybrid model* |
| Type of reliability standard or planning? | Hybrid standards for connection points | Probabilistic planning | Probabilistic planning | Hybrid standards for connection points except for Victoria where probabilistic planning could be retained |
| Standards contained in? | National template and/or jurisdictional instruments. Reliability to remain as a state and territory function | Not specified but most likely reliability to become a national function | Reliability to become a national function | National template. Reliability to become a national function. |
| Who sets the standards? | Jurisdictions with input from expert advisor | AEMO | AEMO in consultation with transmission businesses | AEMO in consultation with transmission businesses |
| Who makes augmentation investment decisions? | Transmission businesses | AEMO | AEMO in consultation with transmission businesses | Transmission businesses |
| Process for planning or setting standards? | AEMO to develop national template. Standards to be ‘informed’ by jurisdictionally appointed body | AEMO probabilistic planning process | AEMO probabilistic planning process, peer reviewed and designed to be international best practice | AEMO to develop national template and set all standards |
| How is revenue allocated? | AER five yearly revenue determination process | Negotiation between AEMO and transmission business before start of non‑separable projects. Contestability for separable projects. | Negotiation between AEMO and transmission business before start of small projects (with AER approval). Separate AER revenue determination process before start of large projects. | AER determination process with the onus of proof on transmission businesses to convince the AER to move away from AEMO recommended investment plan and costs |
| Independent cost-benefit analysis or RIT-T? | Businesses to conduct RIT-T with scrutiny by AEMO | Independent cost-benefit analysis | Independent cost-benefit analysis | Businesses to conduct RIT-T with scrutiny by AEMO |
| Last resort planning power | AEMO | Not specified | AEMO but with the added power of being able to direct investment if the need is considered critical | AEMO but with the added power of being able to direct investment if the need is considered critical |

* The functions of the last resort planning power would be changed to include a power to instruct transmission businesses to invest if AEMO feared underinvestment could expose the network to serious reliability problems. The AER would arbitrate on any final disputes. AEMO would also carry out auditing of transmission networks, including auditing critical equipment, to ensure transmission businesses were augmenting and maintaining their networks appropriately for the purposes of reliability.
* The (superior) existing planning framework in Victoria would be preserved (if that were the preference of the Victorian Government), with the adapted hybrid model only applying to other jurisdictions. Other jurisdictions would be free to adopt the AEMO planner model.

In both of these alternative models, AEMO would set transmission reliability standards. Both models also currently exclude contestability in the procurement of investments and therefore might limit innovation and reduce opportunities for lower costs.

The main drawbacks of the Commission’s modified AEMC hybrid model would be that the levels of reliability delivered are less likely to be efficient and the risks of NEM-wide effects would not be fully accounted for. Jurisdiction-based planning would perpetuate concerns about the intra-regional bias of investments. Moreover, under this alternative, the type, timing and cost of investments are less likely to be efficient. These drawbacks would tend to increase network costs relative to the Commission’s preferred model.

#### In an environment of rising electricity prices, what difference might these changes make?

It is difficult to estimate precisely the net economic benefits of moving to the Commission’s preferred national planning framework. This would require detailed modelling that is currently not possible because of existing data deficiencies.

However, the following examples suggest that the net economic benefits would be significant.

* Deterministic standards have implicit VCRs and it is possible to assess whether augmentations to meet deterministic standards are close to efficient by assessing whether the implicit VCR seems reasonable. For example, AEMO cites a proposed investment in New South Wales to meet an N-1 standard that implied a VCR of $9 million per MWh (around 150 times the estimate AEMO uses in Victoria). This does not seem reasonable and indicates room for significant savings.
* Comparing augmentation plans to meet N-1 deterministic standards with plans that would pass a probabilistic cost-benefit test can reveal differences in costs. In these analyses, the identified savings usually result from deferring investments rather than not augmenting at all. AEMO estimated in 2011 that probabilistic planning in Victoria allowed them to defer $550 million of investment compared to what would have been required under an N-1 deterministic standard. Assuming that similar savings could be identified in all regions of the NEM, these savings could be as high as $2–3 billion. At some point in the future, at least some of this investment is likely to be required. Deferring this investment for one revenue period with a discount rate of 8 per cent would produce savings with a net present value of almost $1 billion.

This is not an unreasonable assumption considering that:

* in some regions deterministic standards can include standards that require more redundancy than N-1
* of all the regions in the NEM, the comparatively higher customer density of the network in Victoria makes it more likely to be able to justify investments to meet N-1 standards under a cost-benefit analysis, suggesting larger differences might exist in other parts of the NEM.
* In New Zealand, augmentations required to meet deterministic criteria were found to be required eight years earlier than they would under a probabilistic cost-benefit analysis. Two types of avoided costs might emerge from deferring investments:
* analysis in New Zealand suggested customers save $75 000 per $1 million of investment deferred (or around 7.5 per cent) over eight years
* considering the possible changes in technology, customer preferences, and prices that can occur in eight years, new and cheaper alternatives might be available in the future.

## 15.9 Delivering reliability in the shorter term

Augmenting networks according to a detailed planning process is one facet of network quality. Network businesses also need to:

* operate their networks safely
* maintain their networks in good working order and make repairs
* deal with possible causes of faults where possible, such as removing vegetation growing close to equipment
* respond quickly to restore supply when an interruption occurs.

#### Service Target Performance Incentive Scheme

The AER developed the Service Target Performance Incentive Scheme (STPIS) for transmission to encourage transmission businesses to maintain network reliability through actions other than building in redundancy.

The STPIS sets targets for:

* circuit availability — the proportion of time that all elements of the network are working and available
* the frequency of outages
* average outage duration
* market impact — designed to encourage businesses to improve availability at times, and on those elements of the network, that are most important to determining spot prices.

Businesses incur penalties (rewards) if they perform below (above) their targets, which are calculated as a percentage of their maximum annual revenue (MAR), referred to as ‘revenue at risk’. The maximum reward or penalty for the three service components of the STPIS in total is 1 per cent of MAR, while it is 2 per cent for the market impact component. The targets, weights for each criteria, and total revenue at risk are unique for each business. In general, targets are set using an average of historical performance over the previous five years, although businesses can propose an alternative target to the AER.

The rewards and penalties are capped, however, they might not be symmetric, depending on the distribution of the historical data.

Notwithstanding the current review of the STPIS, transmission businesses appear to have responded positively to the incentives offered under the scheme (AER 2011e), suggesting that the costs of improving performance have been less than the rewards available. This type of incentive regime, in theory, removes the need for benchmarking these elements of reliability performance, because so long as the potential rewards (penalties) are large enough, a profit motivated business would have an incentive to search for efficiency gains to meet the reliability targets. However, if rewards are too high, customers would pay more for reliability improvements than they cost to achieve.

In the context of a national framework for reliability with a national planner using a probabilistic approach, the STPIS would become an important driver of reliability performance for several reasons.

* To ensure they deliver a reliable supply, transmission businesses would need to rely on operational and performance actions, such as those underlying the criteria in the STPIS, because they would have less control over the level of redundancy in their networks.
* Probabilistic planning is likely to reduce the redundancy in at least some parts of the NEM, which might result in more and longer interruptions to supply unless businesses improve their maintenance, operation and response outcomes.
* Less redundancy in the network might lead to increased congestion on some lines at certain times, especially if the business is carrying out maintenance on that part of the network, which would increase the relative importance of the market impact measure.

Any changes to the STPIS to reflect the increasing importance of operational, maintenance and performance outcomes under a new national planning framework should consider the evaluation criteria already used by the AER in the current review (2011e, p. 12) to ensure that businesses retain the incentive to provide a reliable network up to the point that it is efficient to do so.

#### Dynamic and static equipment ratings

Transmission businesses determine how much power can flow through their equipment at any time. They ensure that they meet the network security standards set out in the Rules by specifying the maximum load that a line or other equipment can carry (so-called equipment ratings).

Network elements can carry different loads in different ambient conditions. In hot, still weather, lines heat up more quickly and droop further, increasing the likelihood of arcing.[[29]](#footnote-29) To recognise that, on average, safe loads can be higher in winter than in summer, and at night than in the middle of the day, transmission businesses vary the maximum load (rating) that lines and equipment can carry. This is currently achieved in two ways.

Static ratings set out the loads that lines or other equipment can carry at different times of the day in different seasons and in some cases, in specific months. These ratings are based on the ambient conditions expected to occur (not those that actually occur) at each time, plus a margin of error for unseasonably high temperatures.

Dynamic ratings measure the ambient temperature around equipment and sometimes the wind speed, and relay this information to operators so that the maximum safe load for that specific point and time can be utilised. On average, lines and equipment with dynamic ratings are used to a higher capacity than those with static ratings. For example, a line with a static rating on a cool, windy night in summer will likely have spare capacity on it.

Ratings that fail to utilise this dynamic approach can be costly where they lead to:

* higher cost generators being dispatched along other parts of the network due to lines reaching their ‘maximum’ static (but not dynamic) load
* network businesses augmenting their networks earlier than necessary because lines are running close to their specified maximum static (but not dynamic) loads.

Static ratings may lead to significant underutilisation of network assets compared with dynamic ratings (with some estimates suggesting that utilisation for some assets could be improved by around 65 per cent for a period of time without any loss of safety). This appears to be one area where large cost savings could be made without sacrificing reliability outcomes.

There has been some adoption of the technologies required to implement dynamic ratings, but the take up has been uneven across the NEM. Victoria has the highest proportion of its network operated with dynamic ratings. It is not clear why the rate of adoption of dynamic ratings has been slow, although the distortions created by the incentives in the regulatory regime (chapter 5) could be one explanatory factor.

## 15.10 Changes to transmission reliability

As the discussion above illustrates, there are many complex issues involved in the setting of reliability standards, their application in the transmission planning process, and other influences on the delivery of reliability in the short term.

Unsurprisingly, there is no single, ‘silver bullet’ solution. Accordingly, the Commission’s proposed improvements for transmission reliability (set out below) encompass a range of topics including technical settings of reliability, responsibility for and transparency in planning and interaction with incentive regulation. These should not be considered on an individual basis, but rather taken as a package of reform for transmission reliability.

draft recommendation 15.1

The Standing Council on Energy and Resources should, in consultation with the Australian Energy Market Operator and the Australian Energy Market Commission, develop a National Electricity Market-wide reliability framework in which reliability settings would be determined by customer preferences.

This framework should replace all jurisdiction-specific reliability settings.

Draft recommendation 15.2

Drawing on the current Victorian experiences, the Australian Energy Market Operator should carry out transmission planning for all transmission networks in the National Electricity Market. The Operator should:

* use Values of Customer Reliability (as obtained through draft recommendation 14.1)
* use best practice probabilistic processes in its cost‑benefit analysis of network and non‑network options to address reliability issues and/or constraints
* describe its full cost‑benefit analysis as part of its process for the Regulatory Investment Test for Transmission
* make public all methodologies, parameters, data and other inputs used in the analysis
* work closely with each of the transmission companies concerned to make sure that their experience and input is fully understood and where mutually agreed, appropriately incorporated into the analysis
* use its best estimate of peak demand forecasts, having sought input from all relevant stakeholders
* ensure that planning decisions are consistent with National Electricity Market‑wide efficiency objectives
* not carry out the ‘procurer’ role currently done in Victoria until it can be demonstrated that the benefits of such an approach exceed the costs in the Australian National Electricity Market environment.

draft recommendation 15.3

In consultation with the transmission network businesses, the Australian Energy Market Operator should specify the details of the network or non‑network solution to an identified constraint.

If the cost of the solution is less than an appropriate threshold, then:

* the Australian Energy Market Operator and the network business should negotiate and agree on the required expenditure. If there is no agreement, the Australian Energy Regulator should determine the allowable spending.

If the costs exceed the above threshold, then:

* the transmission business should submit detailed and final costings to the Australian Energy Regulator
* with advice from the Australian Energy Market Operator, the Australian Energy Regulator should determine the allowable expenditure.

The Australian Energy Regulator should automatically include the relevant agreed allowable expenditure in the revenue allowance for the transmission business.

At the next regulatory reset, the actual capital spent on such projects should be included in the transmission business’s Regulatory Asset Base.

draft Recommendation 15.4

The Australian Energy Regulator should ensure that, in the Australian Energy Market Operator’s role as a transmission planner, its public reporting and planning processes are adequate, transparent and meet the National Electricity Objective.

draft Recommendation 15.5

The Australian Energy Market Operator should review and, where necessary improve, the technical aspects of its probabilistic processes, particularly those relating to low-probability, high risk events. In undertaking the review, the Australian Energy Market Operator should closely consult with network businesses and seek independent peer review of its technical methods.

draft Recommendation 15.6

If the Standing Council on Energy and Resources does not accept draft recommendations 15.2 and 15.3, then it should implement a second best option in which:

* transmission businesses would retain the function of planning and making augmentation decisions
* the Australian Energy Market Operator would set hybrid standards for connection points every five years, with standards that could fall as well as rise, and would provide advice on efficient investment to meet those standards
* in consultation with network businesses, the Australian Energy Market Operator would develop peak demand forecasts. The Australian Energy Regulator would use these demand forecasts in its regulatory determinations in accordance with draft recommendation 8.4
* the National Electricity Rules should be amended to allow the Australian Energy Regulator to accept the Australian Energy Market Operator’s advice on the preferred network and non-network options and their cost as the default proposal, requiring the transmission business to show why its alternative was more efficient
* the Victorian Government should not be required to relinquish its current planning framework, with the adapted hybrid model only applying to other jurisdictions. Other jurisdictions should be free to adopt the Victorian planning model.

draft recommendation 15.7

Where necessary, the Australian Energy Market Operator should assist the Australian Energy Regulator in its compliance and auditing of transmission networks, to ensure that the agreed projects are completed and intrinsic network reliability is maintained.

draft recommendation 15.8

The Australian Energy Market Operator should act as the planner of last resort where it considers that underinvestment could expose the network to serious reliability problems, with the right to direct investment should the Australian Energy Market Operator believe that not to do so could seriously compromise the reliability of the National Electricity Market. The Australian Energy Regulator would act as an arbitrator in any disputes.

draft Recommendation 15.9

The Australian Energy Regulator should review the Service Target Performance Incentive Scheme for Transmission to ensure the incentives and targets are consistent with the new National Electricity Market-wide reliability framework.

draft Recommendation 15.10

Transmission businesses not already using this approach should transition to dynamic capacity ratings on all critical equipment.

1. For example, the Australian Energy Regulator recently approved more than $2 billion in capital expenditure for load driven augmentations and replacements in Powerlink’s latest revenue determination (2012-2017). [↑](#footnote-ref-1)
2. ‘The Group’ includes Loy Yang Management Company Pty Ltd, AGL Hydro Pty Ltd, International Power Australia, TRUenergy Pty Ltd and Flinders Power. [↑](#footnote-ref-2)
3. A secure operating state requires the power system to be in a satisfactory operating state and to be able to return to a satisfactory operating state following the occurrence of any credible contingency. A satisfactory operating state requires all network elements to be loaded within their ratings. AEMO considers contingencies to be credible if it is reasonably possible that they might occur (AEMO 2012e, p. 8). [↑](#footnote-ref-3)
4. A contingency event is an event affecting the power system that AEMO expects would be likely to involve the failure or removal from operational service of one or more generating units and/or transmission elements (The Rules, clause 4.2.3(a)). [↑](#footnote-ref-4)
5. Availability is a measure of the share of time that all transmission assets are in use, (or available to be used). Planned and unplanned maintenance and upgrades take assets out of use and reduce availability. [↑](#footnote-ref-5)
6. On average a line with a capacity of 10 MVA would service less than around 4000 customers. This means that all transmission lines, except very small ones, have N-1 redundancy. [↑](#footnote-ref-6)
7. A connection point is where the transmission network transfers electricity to either a distribution network or a directly-connected large customer. [↑](#footnote-ref-7)
8. As set out in s. 50F of the National Electricity Law. [↑](#footnote-ref-8)
9. The Commission understands that the process outlined in box 15.6 is undertaken in some form in each stage of AEMO’s planning process outlined in figure 15.1. [↑](#footnote-ref-9)
10. A real options approach in the context of transmission planning allows investment decisions for reliability, once a potential constraint has been identified, to be delayed past the start of the regulatory period until the time that they are needed. The benefits of this approach are twofold. Firstly, if predictions about the level of reliability that customers value turn out to be incorrect, the required investment path can be altered. For example, if the value of customer reliability changes because an industrial estate closes down, the level of reliability that the remaining customers desire would fall. The second benefit arises from being able to take advantage of technology improvements or changing financial conditions or other network augmentations built in neighbouring regions. Delaying the decision about exactly what to build and how much it will cost until closer to the time of the project starting, allows the most recent developments to be taken into account. [↑](#footnote-ref-10)
11. A satisfactory operating state requires all network elements to be loaded within their ratings (as defined in chapter 4 of the Rules) (AEMO 2012e, p. xx). [↑](#footnote-ref-11)
12. A secure operating state is defined in footnote three. [↑](#footnote-ref-12)
13. A separable project is one that can readily be identified as distinct from the rest of the network. Further, while it will require connection to the broader network, to be categorised as ‘separable’, a project must not materially interfere with the incumbent transmission business’s ability to run existing infrastructure. [↑](#footnote-ref-13)
14. The revenue is approved by AEMO by changing SP AusNet’s Transmission Use of System (referred to as TUOS) charges. In effect, this allows the business to collect more revenue from customers. [↑](#footnote-ref-14)
15. It is possible that AEMO has an incentive to ‘make life easier’ as the operator by making inefficient investment decisions, however, there does not appear to be evidence to support this conjecture. It is also possible that synergies exist between planning and operating the network, which AEMO can exploit when it carries out both roles. [↑](#footnote-ref-15)
16. One in-principle concern is whether the separation of planning functions from ownership, operation and maintenance could forgo the benefits of trade-offs between capex and opex in delivering reliability in the network. However, this problem is unlikely to be significant since AEMO considers a range of solutions as part of its cost-benefit probabilistic test for any investment and has ongoing consultations with the transmission business (which could raise such alternative solutions). [↑](#footnote-ref-16)
17. One indirect test is whether the values of customer reliability *revealed* from augmentations made in Victoria are reasonably consistent with the measured survey values of customer reliability. [↑](#footnote-ref-17)
18. Underpinned by provisions in the National Electricity Law (Division 2, Subdivision 2, section 50B). [↑](#footnote-ref-18)
19. ElectraNet’s planning and augmentation proposals are subject to public scrutiny by AEMO in the lead up to ElectraNet submitting its revenue proposal to the AER. While ElectraNet is not obliged to follow AEMO’s advice in its proposal, AEMO’s advice provides the AER with more information with which to assess the proposal. [↑](#footnote-ref-19)
20. For example, a large industrial user might move out of an area, causing maximum demand forecasts to fall significantly. [↑](#footnote-ref-20)
21. The VCR used in the calculations is extrapolated from the Victorian VCR (based on the Victorian survey in 2007) using data on sectoral demands for electricity (AEMO 2010e, p. 15). [↑](#footnote-ref-21)
22. The Last Resort Planning Power would give AEMO the authority to direct a transmission business to undertake a RIT-T (but not to direct that investment must occur) for potential transmission projects if they are likely to relieve forecast constraints in parts of the network that connect regions in the NEM. To date, the current Last Resort Planner (the AEMC) has not used this power (AEMC 2012j). [↑](#footnote-ref-22)
23. The AEMC does not comment about whether AEMO would provide advice on draft revenue proposals (as they currently do in South Australia). However, that would be a likely feature of any implemented model following the AEMC’s approach. [↑](#footnote-ref-23)
24. An additional, but lesser, concern is that the requirement that Victoria relinquish its current approach could mean that any profits associated with exploitation of information asymmetries (with the regulator) and cost efficiencies encouraged by incentive regulation would be kept by SP AusNet. Given their foreign ownership, these transfers would actually also represent welfare losses to Australians. [↑](#footnote-ref-24)
25. The flexible approach might reduce some of this rigidity but would probably not address all the limitations of this model. [↑](#footnote-ref-25)
26. The Commission considered, and then rejected, the use of benchmarking of the efficiency of reliability outcomes in South Australia (the hybrid model) compared with Victoria (the AEMO model). As discussed in chapter 4, it is unlikely that benchmarking analysis of this type would be accurate enough to make well-founded regulatory decisions. [↑](#footnote-ref-26)
27. Estimates have suggested that the costs of submitting a tender can be as high as five per cent of the project cost (AEMC 2012j, p. 80). The costs to AEMO of running a tender process could be in the realm of $0.2‑0.3 million, which would make the total cost of the tender process for a project of $10 million as high as 8 per cent. [↑](#footnote-ref-27)
28. However, introducing contestability into the whole NEM might encourage a deepening of the market over time. [↑](#footnote-ref-28)
29. Arcing is when electricity flashes over from one piece of equipment to another, or something else, such as a tree, creating a fault on the network. [↑](#footnote-ref-29)